

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1-21. (Previously Canceled)

22. (Amended) A method of generating object-oriented computer programs for accessing and updating persistently stored objects, ~~wherein the method is performed under program control by a computer,~~ the method comprising:

receiving an initial computer program that includes original instructions for accessing
5 objects stored in a computer's main memory, the original instructions including object accessing instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

scanning the initial computer program to automatically identify said object accessing instructions and corresponding program locations ~~at which additional instructions are to be added~~
10 ~~added~~ representing a first set of identified program locations;

automatically, under computer program control, revising the initial computer program to generate a revised computer program [[by]], said revising comprising modifying ~~data structures of~~ the persistent objects, and said revising further comprising and adding object loading instructions to the initial computer program at the first set of the identified program
15 locations, wherein the added object loading instructions, during execution of the revised computer program, load respective ones of the persistent objects from persistent storage of the computer into the main memory when each respective object is accessed and the respective object is not already in the main memory; and

wherein said modifying the persistent objects comprises modifying object data
20 structures of said persistent objects to store persistent data descriptors, said modifying further comprising adding new methods to the persistent objects, said new methods comprising code allowing access and use of said persistent data descriptors.

23. (Original) The method of claim 22, wherein the added object loading instructions are inactive during execution of the revised computer program except when a respective object to be accessed is referenced by a null location indicator.

24. (Amended) The method of claim 22, ~~the revising further includes:~~ wherein:
each of said persistent data descriptors includes a pointer to a next dirty object;

said revising further includes adding code that adds objects containing new and/or updated data to a linked list of dirty objects using said pointer to said next dirty object adding
5 ~~dirty object marking instructions to the initial computer program that, during execution of the revised computer program, store object marking data indicating which objects in the main memory contain new and/or updated data; and~~

said revising further includes adding object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective said
10 objects in said linked list of dirty objects in the main memory into the persistent storage;

~~wherein the certain respective objects stored into the persistent storage by the object storing instructions contain new and/or updated data as indicated by the object marking data.~~

25. (Canceled)

26. (Amended) A method of generating object-oriented computer programs for accessing and updating persistently stored objects, ~~wherein the method is performed under program control by a computer,~~ the method comprising:

receiving an initial computer program that includes original instructions for accessing
5 and updating objects stored in a computer's main memory and for committing transactions in which one or more objects may have been updated, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

scanning the initial computer program to automatically identify object updating
10 instructions and transaction commit instructions ~~and corresponding program locations at which additional instructions are to be added representing a set of identified program locations;~~

automatically, under computer program control, revising the initial computer program to generate a revised computer program by:

15 ~~modifying data structures of the persistent objects, said modifying the persistent objects comprising modifying object data structures of said persistent objects to store persistent data descriptors, said modifying the persistent objects further comprises adding new methods to the persistent objects, the new methods comprising code allowing access and use of said persistent data descriptors;~~

20 ~~adding at a first subset of the identified program locations~~ dirty object marking instructions to the initial computer program that, during execution of the revised computer program, modifies persistent data descriptors of ~~store object marking data indicating which~~ dirty objects in the computer's main memory which contain new and/or updated data so that said dirty objects can be identified; and

25 ~~adding at a second subset of the identified program locations~~ object storing instructions to the initial computer program that, during execution of the revised computer program, ~~store certain respective~~ said dirty objects in the computer's main memory into the persistent storage, wherein the ~~object marking data~~ persistent data descriptors stored in said object data structures of the persistent object by the dirty object marking instructions is are
30 used by the object storing instructions to identify the certain respective objects.

27. (Amended) The method of claim 26, wherein the persistent data descriptors includes a persistent storage object identifier, the object storing instructions ~~include~~ including instructions for replacing local object references in the certain respective objects with ~~corresponding~~ the persistent storage object identifiers in corresponding ones of the data descriptors before storing the certain respective objects in the persistent storage, wherein the local object references reference objects in the main memory and the persistent storage object identifiers reference objects in the persistent storage.

28. (Amended) A method of generating object-oriented computer programs for accessing and updating persistently stored objects, ~~wherein the method is performed under program control by a computer,~~ the method comprising:

5 scanning an initial computer program to automatically identify object accessing instructions and object updating instructions ~~and corresponding program locations at which additional instructions are to be added,~~ the initial computer program including original

instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

- 10 automatically revising the initial computer program to generate a revised computer program by modifying ~~data structures of~~ the persistent objects and adding supplemental instructions to the initial computer program ~~at the identified program locations, the supplemental instructions including:~~
- 15 ~~_____ a first set of additional instructions, added to the initial computer program at a first subset of the identified program locations associated with identified object accessing instructions, wherein the first set of additional instructions, during execution of the revised computer program, perform a first predefined task when each respective object is accessed and the respective object is not already in main memory of the computer; and~~
- 20 ~~_____ a second set of additional instructions, added to the initial computer program at a second subset of the identified program locations associated with the identified object updating instructions, wherein the second set of additional instructions, during execution of the revised computer program, perform a second predefined task when each respective object is updated for a first time wherein said modifying the persistent objects comprises modifying object data structures of the persistent objects to store persistent data descriptors therein, said~~
- 25 ~~modifying the persistent objects further comprising adding new methods to the persistent objects, the new methods comprising code allowing access and use of the persistent data descriptors, each of said persistent data descriptors including a pointer to a next dirty object, said supplemental instructions adding persistent objects to a linked list of dirty objects using said pointer to a next dirty object in said persistent data descriptors when said object contains~~
- 30 ~~new and/or updated data.~~

29. (Amended) The computer implemented method of claim 28, wherein ~~the first predefined task~~ said supplemental instructions further includes instructions loading respective ones of the objects from persistent storage of the computer into the main memory of the computer when each respective object is accessed and the respective object is not already in the main memory.

30. (Amended) The computer implemented method of claim 29, wherein ~~the second predefined task~~ said supplemental instructions further includes instructions storing

~~object marking data indicating which~~ objects in the main memory that are members of the linked list of dirty objects ~~contain new and/or updated data.~~

31. (Canceled)

32. (Amended) A computer program product for use in a conjunction with a computer having a main memory and persistent storage, the computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism comprising:

5 a postprocessor procedure for modifying an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

the postprocessor procedure including instructions for:

10 receiving an initial computer program that includes original instructions for accessing objects stored in a computer's main memory;

scanning the initial computer program to automatically identify object accessing instructions and corresponding program locations ~~at which additional instructions are to be added~~ representing a first set of identified program locations;

15 automatically, under computer program control, revising the initial computer program to generate a revised computer program [[by]], said revising comprising modifying ~~data structures of~~ the persistent objects, and said revising further comprising ~~and~~ adding object loading instructions to the initial computer program at the first set of the identified program locations, wherein the added object loading instructions, during execution of the revised computer program, load respective ones of the persistent objects from persistent storage of the computer into the main memory when each respective object is accessed and the respective object is not already in the main memory; and

20 wherein said modifying the persistent objects comprises modifying object data structures of said persistent objects to store persistent data descriptors, said modifying further comprising adding new methods to the persistent objects, said new methods comprising code
25 allowing access and use of said persistent data descriptors.

33. (Original) The computer program product of claim 32, wherein the added object loading instructions are inactive during execution of the revised computer program except when a respective object to be accessed is referenced by a null location indicator.

34. (Amended) The computer program product of claim 32, ~~wherein the revising instructions further include instructions for~~ wherein:

each of said persistent data descriptors includes a pointer to a next dirty object;

said revising further includes adding code that adds objects containing new and/or
5 updated data to a linked list of dirty objects using said pointer to said next dirty object adding
~~dirty object marking instructions to the initial computer program that, during execution of the~~
~~revised computer program, store object marking data indicating which objects in the main~~
~~memory contain new and/or updated data; and~~

said revising further includes adding object storing instructions to the initial computer
10 program that, during execution of the revised computer program, store ~~certain respective~~ said
objects in said linked list of dirty objects ~~in the main memory~~ into the persistent storage;

~~wherein the certain respective objects stored into the persistent storage by the object~~
~~storing instructions contain new and/or updated data as indicated by the object marking data.~~

35. (Canceled)

36. (Amended) A computer program product for use in conjunction with a computer having a main memory and persistent storage, the computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism comprising:

5 a postprocessor procedure for modifying an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

the postprocessor procedure including instructions for:

10 receiving an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory and for committing transactions in which one or more objects may have been updated;

scanning the initial computer program to automatically identify object updating instructions and transaction commit instructions ~~and corresponding program locations at which additional instructions are to be added representing a set of identified program locations;~~

automatically, under computer program control, revising the initial computer program to generate a revised computer program by:

~~modifying data structures of the persistent objects, said modifying the persistent objects comprising modifying object data structures of said persistent objects to store persistent data descriptors, said modifying the persistent objects further comprises adding new methods to the persistent objects, the new methods comprising code allowing access and use of said persistent data descriptors;~~

~~adding at a first subset of the identified program locations dirty object marking instructions to the initial computer program that, during execution of the revised computer program, modifies persistent data descriptors of store object marking data indicating which dirty objects in the computer's main memory contain new and/or updated data so that said dirty objects can be identified; and~~

~~adding at a second subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective said dirty objects in the computer's main memory into the persistent storage, wherein the object marking data persistent data descriptors stored in said object data structures of the persistent object by the dirty object marking instructions is are used by the object storing instructions to identify the certain respective objects.~~

37. (Amended) The computer program product of claim 36, wherein the persistent data descriptors includes a persistent storage object identifier, the object storing instructions ~~include~~ including instructions for replacing local object references in the certain respective objects with ~~corresponding~~ the persistent storage object identifiers in corresponding ones of the data descriptors before storing the certain respective objects in the persistent storage, wherein the local object references reference objects in the main memory and the persistent storage object identifiers reference objects in the persistent storage.

38. (Amended) A computer program product for use in conjunction with a computer having a main memory and persistent storage, the computer program product

comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism comprising:

5 a ~~postprocessor~~ procedure for modifying an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

 the ~~postprocessor~~ procedure including instructions for:

10 scanning an initial computer program to automatically identify object accessing instructions and object updating instructions ~~and corresponding program locations at which additional instructions are to be added;~~

 automatically revising the initial computer program to generate a revised computer program by modifying ~~data structures of~~ the persistent objects and adding
15 supplemental instructions to the initial computer program ~~at the identified program locations;~~
 the supplemental instructions including:

~~a first set of additional instructions, added to the initial computer program at a first subset of the identified program locations associated with identified object accessing instructions, wherein the first set of additional instructions, during execution of the revised~~
20 ~~computer program, perform a first predefined task when each respective object is accessed and the respective object is not already in main memory of the computer; and~~

~~a second set of additional instructions, added to the initial computer program at a second subset of the identified program locations associated with the identified object updating instructions, wherein the second set of additional instructions, during execution of~~
25 ~~the revised computer program, perform a second predefined task when each respective object is updated for a first time~~ wherein said modifying the persistent objects comprises modifying object data structures of the persistent objects to store persistent data descriptors therein, said modifying the persistent objects further comprising adding new methods to the persistent objects, the new methods comprising code allowing access and use of the persistent data
30 descriptors, each of the persistent data descriptors including a pointer to a next dirty object, said supplemental instructions adding persistent objects to a linked list of dirty objects using the pointer to a next dirty object in the persistent data descriptors when the object contains new and/or updated data.

39. (Amended) The computer program product of claim 38, wherein ~~the first predefined task~~ the supplemental instructions further includes instructions loading respective ones of the objects from persistent storage of the computer into the main memory of the computer when each respective object is accessed and the respective object is not already in
5 the main memory.

40. (Amended) The computer program product of claim 39, wherein ~~the second predefined task~~ said supplemental instructions further includes instructions storing ~~object marking data indicating which~~ objects in the main memory that are members of the linked list of dirty objects ~~contain new and/or updated data.~~

41-51 (Canceled)

52 (New) The method of claim 22 wherein each of said persistent data descriptors comprises a full DBMS object identifier.

53. (New) The method of claim 22 wherein each of said persistent data descriptors is referenced by a corresponding pointer in a corresponding one of said object data structures.

54. (New) The method of claim 24 wherein said code that adds objects containing new and/or updated data to a linked list of dirty objects comprises code to copy an object pointer in a list header into said pointer to a next dirty object and code to store a pointer to said object containing new and/or updated data in said list header.

55. (New) The method of claim 22 wherein each of said persistent data descriptors includes a full object identifier of each reference in the persistent object to another object.

56. (New) The method of claim 26 wherein said persistent data descriptors are modified by using a pointer to a next dirty object field to include said dirty objects in a linked list of dirty objects, said object storing instructions following said linked list of dirty objects to determine which of said objects contain said new and/or updated data.

57. (New) The computer program product of claim 32 wherein each of said persistent data descriptors comprises a full DBMS object identifier.

58. (New) The computer program product of claim 32 wherein each of said persistent data descriptors is referenced by a corresponding pointer in a corresponding one of said object data structures.

59. (New) The computer program product of claim 34 wherein said code that adds objects containing new and/or updated data to a linked list of dirty objects comprises code to copy an object pointer in a list header into said pointer to a next dirty object and code to store a pointer to said object containing new and/or updated data in said list header.

60. (New) The computer program product of claim 22 wherein each of said persistent data descriptors includes a full object identifier of each reference in the persistent object to another object.

61. (New) The computer program product of claim 36 wherein said persistent data descriptors are modified by using a pointer to a next dirty object field to include said dirty objects in a linked list of dirty objects, said object storing instructions following said linked list of dirty objects to determine which of said objects contain said new and/or updated data.